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$$0 = W_{1.n+1} - w^2 \sin 1''[S_{r.n}]C_1 - \left\{ w^2 \sin^2 1''[W_{r.n}S_{r.n}] - mc^2[(r.r+1) \times \sin z_{r.r+1} \cos z_{r.r+1}] \right\} C_2 + \left\{ w^2 \sin 1''[S_{r.n}] + mc^2[(r.r+1)\sin^2 z_{r.r+1}] \right\} C_3. \quad (5)$$

Having solved these equations, formulæ (3) and (4) will give the required corrections to the observed quantities. The weighted sum of squares of these corrections may then be computed, either directly or indirectly by the formula

$$\frac{1}{w^2}\left[\varDelta(r)^2\right] + \frac{792}{c^2}\left[\frac{\varDelta(r.r+1)^2}{(r.r+1)}\right] = EC_1 - S_{1.n+1}C_2 - W_{1.n+1}C_3. \quad (6)$$

The probable error of weight 1 is then

$$r = 0.6745 \sqrt{[\tfrac{1}{3}(EC_1 - S_{1.n+1}C_2 - W_{1.n+1}C_3)]}. \quad (7)$$

The published solution of this problem as given by Mr. Adcock at p. 60 is not correct for several reasons.

1. He adjusts the angles independent of their relation to the sides and then uses the resulting angle of this partial adjustment as absolutely correct in the adjustment for the sides.

2. He considers the sides all equally good although I only said that the measurement of the sides is liable to c inches per chain; therefore if for instance the side a contains a feet it is measured by $(a \div 66)$ chains, each of which is liable to c inches probable error. Then the sides a, b, etc., are liable to the probable errors

$$c\sqrt{\frac{a}{66}},\quad c\sqrt{\frac{b}{66}},\ \text{etc., respectively.}$$

These are well recognized principles all over the world.

THE NINE-LINE CONIC.

BY MISS CHRISTINE LADD, BALTIMORE, MARYLAND.

THE properties of the nine-line conic may be obtained directly, or by reciprocation from those of the nine-point circle. I shall make use of the latter method. Some of these properties are well known; those which I suppose to have been unnoticed hitherto I shall indicate by Italics. Large letters will, as usual, represent points and small letters lines. As two large letters, BC, denote a line, so do two small letters, bc, denote a point.

$ABC \equiv$ triangle. $a\,b\,c \equiv$ trilateral.

$O \equiv$ centre of circumscribed circle. $o \equiv$ directrix of inscribed conic with arbitrary focus, F.

$O_1, O_2, O_3 \equiv$ middle points of sides.	$o_1, o_2, o_3 \equiv$ third harmonics to pairs of sides; that is, o_1 is fourth harmonic to b, c, and $(bc)F$, &c. The points on them which subtend a right angle at the focus are on the straight line o.
$P_1, P_2, P_3 \equiv$ feet of perpendiculars from vertices on opposite sides.	$p_1, p_2, p_3 \equiv$ lines through each vertex and the point on the opposite side which subtends with it a right angle at the focus.
$P \equiv$ intersection of perpendiculars.	$p \equiv$ line through these three points.
$N \equiv$ centre of nine-pt. circle.	$n \equiv$ directrix of nine-line conic; that is, *a conic may be drawn with focus* F *and tangent to* $\mathrm{o}_1, \mathrm{o}_2, \mathrm{o}_3$; *to* $\mathrm{p}_1, \mathrm{p}_2, \mathrm{p}_3$; *and to the third harmonics respectively to* p, a; p, b; p, c.
$ON = NP$.	n *passes through the intersection of* o *and* p, *and is their third harmonic.*
G, $\equiv$ centroid (centre of gravity), is on OP.	*The lines* $\mathrm{o}_1, \mathrm{o}_2, \mathrm{o}_3$ *intersect the sides* a, b, c *respectively in three points on one straignt line,* g, *which passes through the intersection of* o *and* p.
$I, E_1, E_2, E_3 \equiv$ centres of inscribed and exscribed circles.	The bisectors, external and internal, of the angles which the sides of the trilateral subtend at the focus cut those sides in six points on four right lines, i, e_1, e_2, e_3. These lines are the directrices of the four conics with focus F which may be circumscribed about $a\ b\ c$. (Salmon, *Conic Sections*, p. 367.)
The nine-point circle is tangent to the in–and exscribed circles.	*The nine-line conic is tangent to each of the four circumscribed conics.*
IA bisects the angle A.	The focal chords of two points on a conic are equally inclined to the line joining to the focus the intersection of the directrix with the line through the two points.
The nine-point circles of the △s BIC, CIA, AIB pass through the points of contact of the circles I, N.	*The nine-line conics of the trilaterals* b i c, c i a, a i b, *are tangent to the one real common tangent to the conics whose directrices are* i *and* n.
The quadrangles $IBCE_1$, E_1BCE_2, &c., are inscriptible in circles whose centres are on the circumference of the circle O.	*The conics with focus* F *inscribed in the quadrilaterals* i b c e_1, e_1 b c e_2, *&c., have their directrices tangent to the conic inscribed in* a b c.

P is the radical centre of the circles on *BC*, *CA*, *AB* respectively as diameters.	p *is the only real axis of similitude to the three conics with focus* F *tangent to* a *and* b, b *and* c, c *and* a *respectively, and having for their respective directrices the third harmonics to those pairs of lines.*
The feet of perpendiculars from any point *M*, of a circumfe'ce on the sides of an inscrib'd trian. lie on the line of Simson. The line of Simson bisects *MP*.	Lines drawn from the vertices of a triangle to the points on a tangent, *m*, to the inscribed conic which subtend with them a right angle at the focus meet in a point, which we shall call the point of Simson. *The point of Simson is on the third harmonic to* m *and* p.
Lines from the vertices of a triangle to the middle points of corresponding sides of its orthocentric triangle meet in a point.	*Through the vertices of the trilateral* $p_1p_2p_3$, *draw the third harmonics to its sides. They intersect the corresponding sides of the trilateral* a b c *in three points on one straight line.*
The nine-point circle touches the twelve circles inscribed and exscribed to the triangles *APB*, *BPC*, *CPA*.	*The nine line conic touches the twelve conics with focus* F *that may be circumscribed to the trilaterals* a p b, b p c, c p a.
The circle *O* touches the sixteen circles in-and exscribed to the four triangles *AFB*, AE_1B, &c.	*The inscribed conic touches the sixteen conics with focus* F *that may be circumscribed to the four trilaterals* a f b, a e_1 b, &c.

Mr. Casey gives 1024 remarkable points on the nine-point circle, and M. Catalan has increased largely the number. Each point has, of course, a corresponding remarkable line tangent to the nine-line conic, but they are not so remarkable as to make it worth while to write down any more of them.

Miscellaneous Problems.—(1). Required to sum the series of squares of the Binomial coefficients, or to prove that

$$1+n^2+\left(\frac{n(n-1)}{1.2}\right)+\ldots=\frac{2n(2n-1)\ldots(2n-n+1)}{1.2.3\ldots n}.$$

(2). Required to transform the first of the following series into the second, where v may be assumed at pleasure.

$$S=ax+bx^2+cx^3+dx^4+ex^5+\ldots.$$

$$S=a\left(\frac{x}{1-vx}\right)-(av-b)\left(\frac{x}{1-vx}\right)^2+(av^2-2bv+c)\left(\frac{x}{1-vx}\right)^3-\ldots$$